



AEROSPACE STANDARD

AS85598™

Issued 2021-02

Superseding MIL-B-85598

Bearings, Elastomeric
General Specification for

RATIONALE

This document was a MIL-SPEC that has been converted to this AS Standard. It was last revised in 1988, but it continues to be called out in contracts and drawing packages. The ACBG committee is the owner of this document and the Plain Bearing subcommittee voted to have it converted to an AS Standard, generalized and updated.

NOTICE

The initial SAE publication of this document was taken directly from U.S. Military Standard MIL-B-85598. This SAE Standard may retain the same part numbers established by the original military document.

Any requirements associated with Qualified Products Lists (QPLs) may continue to be mandatory for DoD contracts. Requirements relating to QPLs have not been adopted by the SAE for this standard and are not part of this SAE document.

1. SCOPE

1.1 Scope

This standard defines general requirements for spherical, radial-journal, conical, and thrust bearings which are of laminated elastomeric construction. These bearings are for use in an environment having a temperature spectrum of -65 to +160 °F while reacting steady state loads in addition to oscillating loads and motions. The operating temperature range of -65 to +160 °F reflects the current temperature range for existing parts, but allows for expansion in the future.

1.2 Classification

Bearings shall be specified by the following classes depending on configuration. The figures identifying the classes below shall not necessarily prescribe the internal geometry:

Bearings containing one lamination geometry:

Class A – Radial journal bearing (see Figure 1)

Class B – Conical bearing (see Figure 2)

Class C – Spherical thrust bearing (see Figure 3)

Class D – Thrust bearing (see Figure 4)

Class E – Spherical rod end bearing (see Figure 5)

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Bearings containing two different lamination geometries:

Class AE – Spherical radial journal bearing (see Figure 6)

Class BE – Spherical conical bearing (see Figure 7)

1.3 Part number

Part numbers will be as specified on the applicable procuring agent's specification sheet or manufacturing drawing.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this document to the extent specified herein. The applicable issue of these publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

AMS1424	Fluid, Aircraft Deicing/Anti-Icing Fluid, Aircraft, SAE Type 1
AMS2629	Fluid, Jet Reference
AMS2817	Packaging and Identification of Molded Elastomeric Seals and Sealing Components
AS478	Identification Marking Methods
AS1933	Age Controls for Hose Containing Age-Sensitive Elastomeric Material
AS5316	Storage of Elastomer Seals and Seal Assemblies Which Include an Elastomer Element Prior to Hardware Assembly
AS8879	Screw Threads – UNJ Profile, Inch Controlled Radius Root With Increased Minor Diameter
AS9145	Aerospace Series – Requirements for Advanced Product Quality Planning and Production Part Approval Process

2.1.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM D395	Standard Test Methods for Rubber Property-Compression Set
ASTM D412	Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension
ASTM D429	Standard Method for Rubber Property-Adhesion to Rigid Substrates
ASTM D910	Leaded Aviation Gasolines, Standard Specification for
ASTM D1418	Standard Practice for Rubber Products and Rubber Latices – Nomenclature
ASTM E1417/E1417M	Standard Practice for Liquid Penetrant Testing

ASTM E1444/E1444M Standard Practice for Magnetic Particle Testing

ASTM F25 Method for Sizing and Counting Airborne Particulate Contamination in Clean Rooms and Other Dust-Controlled Areas Designed for Electronic and Similar Applications

ASTM F50 Practice for Continuous Sizing and Counting of Airborne Particles in Dust-Controlled Areas Using Instruments Capable of Detecting Single Sub-Micrometer and Larger Particles

2.1.3 ASME Publications

Available from ASME, P.O. Box 2900, 22 Law Drive, Fairfield, NJ 07007-2900, Tel: 800-843-2763 (U.S./Canada), 001-800-843-2763 (Mexico), 973-882-1170 (outside North America), www.asme.org.

ASME B46.1 Surface Texture (Surface Roughness, Waviness and Lay)

ASME Y14.100 Engineering Drawing Practices

2.1.4 U.S. Government Publications

Copies of these documents are available online at <https://quicksearch.dla.mil>.

MIL-STD-129 Military Marking for Shipment and Storage

MIL-STD-130 Identification Marking of U.S. Military Property

MIL-DTL-197 Packaging of Bearings, Anti-Friction, Associated Parts and Sub-Assemblies

MIL-PRF-680 Degreasing Solvent

MIL-HDBK-695 Rubber Products: Recommended Shelf Life

MIL-STD-810 Environmental Engineering Considerations and Laboratory Tests

MIL-STD-889 Dissimilar Metals

MIL-STD-1907 Inspection, Liquid Penetrant and Magnetic Particle, Soundness Requirements for Materials, Parts, and Weldments

MIL-STD-2073 Standard Practice for Military Packaging

MIL-PRF-5606 Hydraulic Fluid, Petroleum Base, Aircraft; Missile and Ordnance

MIL-DTL-5624 Turbine Fuel, Aviation, Grades JP-4 and JP-5

MIL-PRF-7808 Lubricating Oil, Aircraft Turbine Engine, Synthetic Base

MIL-PRF-23699 Lubricating Oil, Aircraft Turbine Engine, Synthetic Base, NATO Code Numbers O-152, O-156, and O-167

MIL-DTL-83133 Turbine Fuel, Aviation, Kerosene Type, JP-8 (NATO F-34), NATO F-35, and JP-8+100 (NATO F-37)

MIL-PRF-83282 Hydraulic Fluid, Fire Resistant, Synthetic Hydrocarbon Base, Metric, NATO Code Number H-537

MIL-PRF-87937 Cleaning Compound, Aerospace Equipment

2.1.5 ANSI Accredited Publications

Copies of these documents are available online at <http://webstore.ansi.org/>.

ANSI/ASQ Z1.4 Sampling Procedures and Table for Inspection by Attributes

2.2 Order of Precedence

In the event of a conflict between the text of this standard and the references cited herein (except for associated detail specifications, specification sheets, airframe manufacturer's drawings, or AS standards), the text of this standard shall take precedence. Nothing in this standard, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

2.3 Definitions

2.3.1.1 BUCKLING

Layered elastomeric instability under compression.

2.3.1.2 CAVITATION

Cohesive fracture initiation due to tensile stress loads.

2.3.1.3 COMPRESSION STRAIN

Compression strain is defined by elastomer wall. Compression strain = (deflection in the compression direction/rubber wall thickness) X 100.

2.3.1.4 STIFFENING FACTOR CALCULATION

The stiffening factor equals the dynamic shear stiffness at the specified test temperature divided by the dynamic shear stiffness at 75 °F ± 15 °F with both shear stiffness values reached at the same dynamic input (±35%).

3. REQUIREMENTS

3.1 Specification Sheets

The individual item requirements shall be as specified herein and in accordance with the applicable procuring agent's specification sheet or manufacturing drawing. In the event of any conflict between the requirements of this standard and the specification sheet/airframe manufacturer's drawing, the latter shall govern.

3.2 Qualification

Bearings furnished under this standard shall be products which are authorized by the qualifying agent (either procuring agent or testing laboratory) at the time of award of contract (see 4.3).

3.2.1 Product Change

Written approval from the qualifying agent is required for any changes that adversely affect form/fit/function or features/properties that are otherwise controlled by purchase order or other specification. Resubmittal of bearing for qualification inspection may be required.

3.2.2 Requirements for Qualification Approval

Qualification approval is based on the satisfactory performance of test bearings to the requirements of this standard. A test configuration which meets the qualification approval criteria of this standard shall secure qualification approval for all production bearings having that test condition number listed on the specification sheet or drawing.

Prior to initiating the evaluation tests, the manufacturer shall notify the qualifying agent of the intention to submit for qualification approval. The letter of notification shall state the proposed date of initiation of the tests, and the test condition for which qualification approval is desired. Upon completion of the test program, the test data shall be reported in accordance with 3.2.5. (Note: Data generated during the development phase is not acceptable.) The report shall be submitted to the procuring agent.

3.2.3 Performance Requirements for Qualification Test Bearings

The bearings for qualification shall be tested in accordance with the following parameters.

3.2.3.1 Static Spring Rates

The axial, radial, torsional and cocking static spring rates shall be measured for each bearing if applicable, and be within the limits specified by the procuring agent.

3.2.3.2 Low Temperature Spring Rate Characteristic

The shear stiffening factor (see 6.3.3) shall be measured at -65 °F and -45 °F in accordance with 4.7.7.7 and be within the limits specified by the procuring agent (an example of a graph delineating limits can be seen in Figure 8, for reference only).

3.2.3.3 Static Strength

The minimum axial or radial static strength of the bearings shall be measured (see 4.7.5) and not be less than specified by the procuring agent.

3.2.3.3.1 Axial Static Strength

The axial static strength of the bearing shall be determined by applying a cocking angle simultaneously with increasing axial load, (angle and load to be specified by the procuring agent) without evidence of permanent damage to the bearing components.

3.2.3.3.2 Radial Static Strength with Axial Load

The bearing shall pass a radial static strength test by applying an axial load simultaneously with a radial load (loads to be specified by the procuring agent) without evidence of permanent damage to the bearing components.

3.2.3.4 Endurance Tests

The bearings shall be validated against the test profile (durations, frequencies, loads, and motions) as specified by the procuring agent; a general recommendation for evaluating failure shall be a two phase approach: damage initiation and propagation with general failure criteria as specified in Table 4 (see 4.7.6). Time spent testing post application requirement should be specified by the procuring agent.

3.2.4 Environmental Requirements for Qualification Test Bearings or Test Specimens

A test bearing or test specimen shall be subjected to the following environmental conditions:

- a. Salt fog (see 4.7.7.2)
- b. Fungus (see 4.7.7.3)
- c. Ozone (see 4.7.7.4)
- d. Hydraulic fluid (see 4.7.7.5a)
- e. High temperature (see 4.7.7.6)

After exposure to the environmental conditions, the bearing or test specimen shall undergo as a minimum a tensile test (ASTM D412) and compression set (ASTM D395). The procuring agent may allow the use of previously established test data to avoid redundant testing.

3.2.5 Requirements for Recording Design and Test Data

The test data shall be recorded and summarized in report form. To ensure statistical accuracy of test data, the bearing supplier (or the testing laboratory) shall certify that the data presented is the performance data for all bearings tested and that no data has been deleted. Any test malfunction resulting in an invalid test shall be noted in the report. A dated drawing describing critical interface dimensions, metal specification, surface finish and elastomer designation of the bearing shall be included. These data shall be submitted to the procuring agent and any data supplied remains the property of the supplier.

3.3 First Article Inspection

The first article shall be the first production lot consisting of complete bearings. The manufacturer shall furnish sample units for first article inspection (see 4.4) and approval (see 6.2). Unless otherwise specified in the contract or order, first article shall not be required on subsequent production lots.

3.4 Materials

Materials shall be as specified on the applicable procuring agent's specification sheet or manufacturing drawing. Unspecified materials shall be at the option of the bearing manufacturer subject to the limitations of 3.2.1.

3.4.1 Elastomer and Nonmetallic Materials

The elastomer used in the fabrication of the bearing shall be selected by the manufacturer and have been tested and approved in accordance with 4.7.7. To support effective management of shelf life controls, elastomeric products shall be identified with their appropriate rubber class designation (refer to ASTM D1418). Nonmetallic materials shall be resistant to all hydraulic fluids, lubricating oils and preservative compounds throughout temperature ranges specified herein unless otherwise determined by the procuring agent.

3.4.2 Bonding, Materials, and Processes

Procedures for bonding and molding of the bearing shall be determined by the manufacturer, subject to the requirements of this standard.

3.4.3 Corrosion Resistance of Metal Parts

Metal parts shall have corrosion-resistant characteristics (or shall be suitably protected by coatings) to resist corrosion which may result from moisture, salt spray, and/or high temperature. Dissimilar metals as defined in MIL-STD-889 which are in direct contact with each other shall be avoided. If unavoidable, such bi-metallic couples shall be protected with appropriate plating or finishes, insulating tapes, sealants, or other approved methods in accordance with MIL-STD-889.

3.5 Design and Construction

The production bearing design and construction (e.g., dimensions, materials, finishes, metal specification, etc.) shall be as specified herein and in accordance with the applicable drawing. The detailed mechanical design of the bearing including elastomeric edge contouring and the design of the rubber/shim package (alternating layers of rubber and metal) shall be accomplished by the manufacturer, subject to the requirements of this standard and the applicable referenced specifications, publications and drawings. The requirements of this standard are detailed only to the extent considered necessary to obtain the desired mechanical characteristics, performance and permanency of the bearings. Upon acceptance of the first bearing by the procuring agent, the manufacturer shall make no change in materials, design, manufacture or process without written approval of the procuring agent (see 3.2.1). Minor variations in elastomer blending ratios are acceptable providing that the finished product meets the same form/fit/function/life as the qualified product.

3.5.1 Dimensions and Tolerances

Dimensions and tolerances shall be as specified on the applicable procuring agent's specification sheet or manufacturing drawing. Dimensions not specified shall be at the option of the manufacturer. The dimensions specified shall be measured after plating, prior to painting, and before load deflection tests. Any dimension not applicable following load deflection tests shall be indicated on the applicable procuring agent's specification sheet or manufacturing drawing.

3.5.2 Elastomeric Parts Shelf Life

The shelf life of age-sensitive elastomeric bearings shall be as specified on the applicable procuring agent's specification sheet or manufacturing drawing or in accordance with AS5316 or MIL-HDBK-695. The shelf life is generally expressed in terms of quarter of calendar year and year (e.g., 4Q-20) from the date of manufacture of the elastomeric component.

3.5.3 Standard and Commercial Parts

Standard parts shall be used whenever they are suitable and shall be identified on the manufacturer's drawing by their part number. Commercial parts may be used provided they conform to all requirements specified herein.

3.5.4 Threaded Parts

Materials for threaded parts shall be selected or treated to preclude galling or seizing. Threads shall be in accordance with AS8879 unless otherwise specified on the applicable procuring agent's specification sheet or manufacturing drawing, with the exception of pitch link and damper rod ends where more than 1D of thread engagement is common.

3.5.5 Surface Texture

Surface texture of the metal parts used in the bearings shall not be more than Ra 125 µin when checked in accordance with ASME B46.1.

3.5.6 Weight

The maximum weight of the bearings shall be as specified on the applicable procuring agent's specification sheet or manufacturing drawing.

3.6 Production Identification and Marking

Each bearing shall be permanently and legibly marked with the manufacturer's identification, part number, date of manufacture, and lot number or serial number. Where space permits, other information as specified on the applicable procuring agent's specification sheet or manufacturing drawing shall be marked. Metal impression stamping should be avoided in critically stressed regions.

3.6.1 Specification Part Number

The specification part number shall be as defined on the applicable procuring agent's specification sheet or manufacturing drawing.

3.7 Interchangeability

All bearings having the same part number shall be directly and completely interchangeable with each other with respect to installation and performance. The drawing part number requirements of DOD-STD-100 shall govern documentation of and changes in the manufacturer's part number.

3.8 Performance Requirements

The bearings shall meet all specified mechanical characteristics and have a test life without failure as defined by the procuring agent. The bearings shall also meet these requirements during and after exposure to the environmental conditions (and possible combinations of) listed herein. The combinations of environments do not imply mixtures of fluids. The appearance of surface cracks or surface deterioration due to environmental exposure shall not constitute failure but shall be evaluated by the manufacturer and the procuring agent as to its possible impact on the service life of the bearings. At the bearing manufacturer's option, a standard laboratory shear test specimen may be used to demonstrate bearing performance under environmental conditions. If used, the test specimen shall be made of the same elastomer formulation specified on the applicable drawing (but not necessarily the same modulus).

3.8.1 Service Life

The bearings shall have a service life of not less than that required on the applicable procuring agent's specification sheet or manufacturing drawing.

3.8.2 Mechanical Characteristics

3.8.2.1 Static Spring Rates

The static spring rates shall be as specified on the applicable procuring agent's specification sheet or manufacturing drawing (see 4.7.3).

3.8.2.2 Static Axial Compression Strength

The minimum static axial compression strength of the bearings shall be as specified on the applicable procuring agent's specification sheet or manufacturing drawing (see 4.7.5 and 4.7.5.1).

3.8.2.3 Static Radial Compression Strength

The minimum static radial compression strength of the bearings shall be as specified on the applicable procuring agent's specification sheet or manufacturing drawing (see 4.7.5, 4.7.5.2, and 4.7.5.3).

3.8.2.4 Low Temperature Spring Rate Characteristics

The bearings shall provide shear stiffening factor characteristics at -65 °F and -45 °F within the limits required by the procuring agent (see 4.7.7.7).

3.8.2.5 High Temperature Spring Rate Characteristics

A limit for the change in dynamic spring rate at 160 °F compared to room temperature shall be determined by the procuring agent.

3.8.2.6 Bearing Motions

The bearings shall accommodate the maximum motions as specified on the applicable procuring agent's specification sheet or manufacturing drawing without bond failure, elastomer tearing, or metal-to-metal contact. Evaluation for these failures may use visual inspection methods and/or shear/torsion stiffness criteria.

3.8.3 Environmental Conditions

3.8.3.1 Humidity

The bearings shall withstand the effects of a relative humidity up to 100% including conditions where condensation occurs per application requirements.

3.8.3.2 Salt Fog

The bearings shall withstand exposure to salt-sea atmosphere per application requirements.



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3.8.3.3 Fungal Growth

The bearings shall withstand exposure to fungus growth as required by application.

3.8.3.4 Ozone

The bearings shall withstand exposure to a concentration of 25 parts per hundred million (pphm) $\pm$ 5 parts per hundred million (pphm) of ozone in air by volume per application requirements.

3.8.3.5 Fluid Exposure

The bearings shall withstand limited exposure to MIL-PRF-5606 and MIL-PRF-83282 hydraulic fluids, MIL-PRF-7808 and MIL-PRF-23699 lubricating oils, MIL-DTL-5624 and MIL-DTL-83133 turbine fuels, ASTM D910 gasoline, MIL-PRF-680 Type I dry cleaning solvent, AMS1424 deicing fluid, and MIL-PRF-87937 cleaning compound in accordance with the applicable procuring agent's specification sheet or manufacturing drawing.

3.8.3.6 Sunlight

The bearings shall withstand exposure to sunlight as required by application.

3.8.3.7 Temperature

The bearings shall operate in an environment having a temperature spectrum within a maximum ambient atmospheric temperature range of -65 to 160 °F or in accordance with the applicable procuring agent's specification sheet or manufacturing drawing.

3.8.3.8 Storage

The bearings shall withstand storage in the following environments (also refer to AS5316) or in accordance with the applicable procuring agent's specification sheet or manufacturing drawing:

- a. High temperature: 190 °F for 1 hour/24 hour day for 30 days
- b. High humidity: 95% relative humidity at 150 °F for 6 hours/24 hour day for 30 days

NOTE: The requirements shown here for High temperature/High humidity are application specific and provided only as an example. A typical way to check shelf life in extreme conditions would be spring-rate, ultimate load capability, etc.

3.9 Process Control Inspection

Process control inspections consist of examinations and tests that will be performed on the bearing prior to or at the appropriate stage of manufacture as well as to the finished bearing. Process control inspections include:

Nomenclature	Requirement Paragraph	Test Method Paragraph
Elastomer bond evaluation	3.9.1	4.7.2.1
Ultimate bond failure criteria	3.9.2	4.7.2.2
Material defect inspection	3.9.3	4.7.2.3
Elastomer-to-metal orientation	3.9.4	4.7.2.4

3.9.1 Elastomer Bond Evaluation

The elastomer-to-metal bond of each bearing shall be evaluated by a proof test of predetermined load/deflection criteria that will reveal a poor quality bond without causing permanent damage to the bearing (special care should be taken not to exceed cavitation limits). Load direction and minimum load and deflection criteria shall be recommended by the manufacturer and approved by the procuring agent.